made Vice-Chancellor of the University of Sydney. He was for several years President of the Royal Society of New South Wales, and we may mention that he was the only graduate of Sydney ever elected to the Royal Society, of which he became a Fellow in 1886. In 1891 Mr. Russell was made Companion of the Order of St. Michael and St. George. In 1903 he had a severe illness, from which he was scarcely expected to recover, and ever since he had suffered from indifferent health; finally he succumbed, in his 71st year, on 1907 February 22. He leaves a widow, with one son and four daughters.

He was elected a Fellow of the Society 1871 February 10.

T. L.

Asaph Hall was born at Goshen, Connecticut, on the 15th of October 1829. At one time wealthy, the family had become poor, and Asaph Hall was apprenticed to a carpenter. Intending, however, to become an architect, he studied mathematics in his spare time. Finally, in 1856, he entered the University of Michigan and studied astronomy under Dr. Brünnow. Leaving Michigan, he became an assistant at Harvard Observatory, under Bond, where he remained until his transfer to the Naval Observatory at Washington in 1862. In the following year he was made Professor of Mathematics. He was amongst the earliest astronomers to appreciate the value of observations of Mars for determining the parallax of the Sun; his investigations, in 1862, of the solar parallax by this means is his first paper of note. From observations made at Upsala, Santiago, and Washington, he deduced the value of $8''.84$ for the solar parallax. In these early years at Washington he also published *A Catalogue of 151 Stars in the cluster of Præsepe*, and *A Study of Comets Faye and Winnecke*, showing that there was no retardation due to a resisting medium. In 1870 he published in the *American Journal of Science* an interesting paper on the "Secular Perturbations of the Planets." An important paper on the "Determination of Longitudes by Moon Culminations" appears in vol. xxxiii. of our *Monthly Notices*. About this time he was giving great attention to minor planets, both by observation and computation. Thus in the *Astronomische Nachrichten*, 1875, will be found a discussion of the Washington observations of Flora, and in the same publication for 1874 a determination of the orbit of Alceste. Throughout this period, too, he contributed numerous mathematical papers to the *American Journal of Science* and the *Messenger of Mathematics*.

In 1875 he took charge of the 26-inch Washington refractor, and made numerous measures of double-stars, diameters of planets, and distances and positions of satellites, which, with his drawings of Mars and Saturn, appear in the volumes of *Washington Observations*. Sir W. Herschel in 1794 found the rotation period of Saturn to be $10^h\ 16^m$, and from that time to 1876 no one appears to have made an attempt to verify this time. Professor Hall set this down as one of his tasks, and on December

7, 1876, he was fortunate enough to find near Saturn's equator a bright spot. This he followed for sixty rotations, and was enabled to fix its period of rotation as $10^h\ 14^m\ 24^s$, a value which has subsequently been found by other observers. It will thus be seen that Asaph Hall was an excellent observer, and fully alive to the needs of astronomy. It is not surprising, therefore, that, being equipped with so powerful an instrument as the 26-inch Washington refractor, he should decide in 1877 to begin a systematic search for possible satellites of Mars. On August 11, the second day of his work, he discovered an object which he suspected to be a satellite. Bad weather intervening, he did not obtain another chance till August 16, when his suspicions were confirmed; on the following night, while watching for the satellite, he found a second moon nearer to Mars. The quick movements of this inner satellite were perplexing, and, to quote Professor Hall's words, "it would appear on different sides of the planet on the same night; and at first I thought that there were two or three inner moons, since it seemed to me at that time very improbable that a satellite should revolve around its primary in less time than that in which the primary rotates." His observations of August 20 and 21, however, satisfied him that there was but one inner moon. In 1878 he published the orbital elements of these satellites, showing that Deimos completed its revolution in $30^h\ 17^m\ 54^s$, and Phobos in $7^h\ 39^m\ 14^s$. For his discoveries he received in 1878 the Lalande Prize of the Paris Academy of Sciences. In 1879 Lord Lindsay, as President, presented him with the Gold Medal of our Society for "his discovery and observations of the satellites of Mars, and for his determination of their orbits." In the same year he received the degree of LL.D. from Yale College.

In 1882 Nyrén gave reasons for supposing Struve's constant of aberration should be increased from $20''\cdot445$ to $20''\cdot492$, which, combined with Newcomb's determination of the velocity of light, gave $8''\cdot794$ as the solar parallax. Loewy, in 1891, had made investigations tending to show that Struve's value should be retained, and at this juncture Professor Hall, from observations of α Lyræ since 1862, had found the value $20''\cdot454$, upholding Struve, and making the corresponding parallax $8''\cdot81$.

Professor Hall devoted much time to the measurement of double-stars; his measures of the companion of Sirius from 1872 to 1888 form a fine series, and give the place of the satellite till its separation from Sirius was only $5''\cdot3$. The whole of his double-star measures are published in two volumes, one containing his work during the years 1875–1880, the other 1881–91. This work led to investigations of the parallax of α Lyræ and of 61 Cygni. He also gave special attention to measuring the diameters of the various planets, and of the distances and positions of their satellites, and, as was the case with all his observations, he followed up the measures with investigations of elements, particularly of Mimas, Enceladas, Tethys, Dione, Rhea, and Titan, which are in Appendix i. of the

Washington Observations, 1883; of Oberon and Titania, the outer satellites of Uranus, in 1881, Appendix i.; while in Appendix ii. he gives a determination of the orbit of the satellite of Neptune, and deduces the mass of Neptune. Finding that most of the measures of Hyperion had been made near one elongation, he made measures in 1875 and 1876 with the 26-inch, and computed an orbit. His mathematical papers were numerous, and covered most astronomical investigations.

Professor Hall had taken part in several observational expeditions, such as—the solar eclipse of 1869 (Behring Straits), of 1870 (Sicily), and of 1878 (Colorado); the transit of Venus of 1874 (Vladivostock) and of 1882 (Texas). In 1891 he retired from the Navy, and in 1896 he was elected to one of the Professorships of Astronomy at Harvard. His death occurred on 1907 November 22. He was elected an Associate of the Society 1879 Jan. 10. T. L.

Pierre Jules César Janssen was born at Paris on the 22nd of February 1824. He was descended from a family which originally dwelt at Liége. His father was a well-known musician, and his mother the daughter of an architect of some celebrity in Paris. An unfortunate accident when young, through the carelessness of a nurse, rendered him lame for life. The boy seems to have been endowed with considerable talent, which he at first exercised in drawing and painting. At the age of sixteen he entered into business as a clerk at a bank, in which he remained for seven or eight years, but during this period he devoted his spare time to the study of mathematics, which so absorbed him that he determined to quit business and to study science. He entered the Collège Bonaparte, and about 1850 took his degree as Bachelier-ès-Sciences. Subsequently at the Sorbonne he attended the lectures of Chasles, Cauchy, Lefébure, Le Verrier, and Sturm, and in 1852 received the degree of Licentiate of Mathematical Science, and later on that of Physical Science.

At the early part of Le Verrier's direction of the Paris Observatory, Janssen was with him as a computer; but the occupation not being very congenial to him, he did not long remain at the observatory, and for the next two years he became Assistant Professor of Mathematics at the Lycée Charlemagne.

In 1856 he made a tour in Turkey, Asia Minor, and Egypt, and in 1857–58 he undertook a scientific expedition to Peru to investigate and determine the position of the magnetic equator. In this he was assisted by his pupils Ernest and Alfred Grandidier. Unhappily he was seized with serious illness, from which he nearly died, and which compelled him to abandon the enterprise, and to sail for Europe to recover his health.

Soon after his return to France he commenced those researches that have made the name of Janssen illustrious in the domain of Solar Physics.

His first published scientific paper appeared in the *Comptes Rendus* for 1860, under the title "Sur l'absorption de la chaleur